PB-239 662

LAKE LE HOMME DIEU, DOUGLAS COUNTY, MINNESOTA

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center
Minnesota Pollution Control Agency
Minnesota National Guard

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT

ON

LAKE LE HOMME DIEU

DOUGLAS COUNTY

MINNESOTA

EPA REGION V

WORKING PAPER No. 106

WITH THE COOPERATION OF THE

MINNESOTA POLLUTION CONTROL AGENCY

AND THE

MINNESOTA NATIONAL GUARD

NOVEMBER, 1974

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

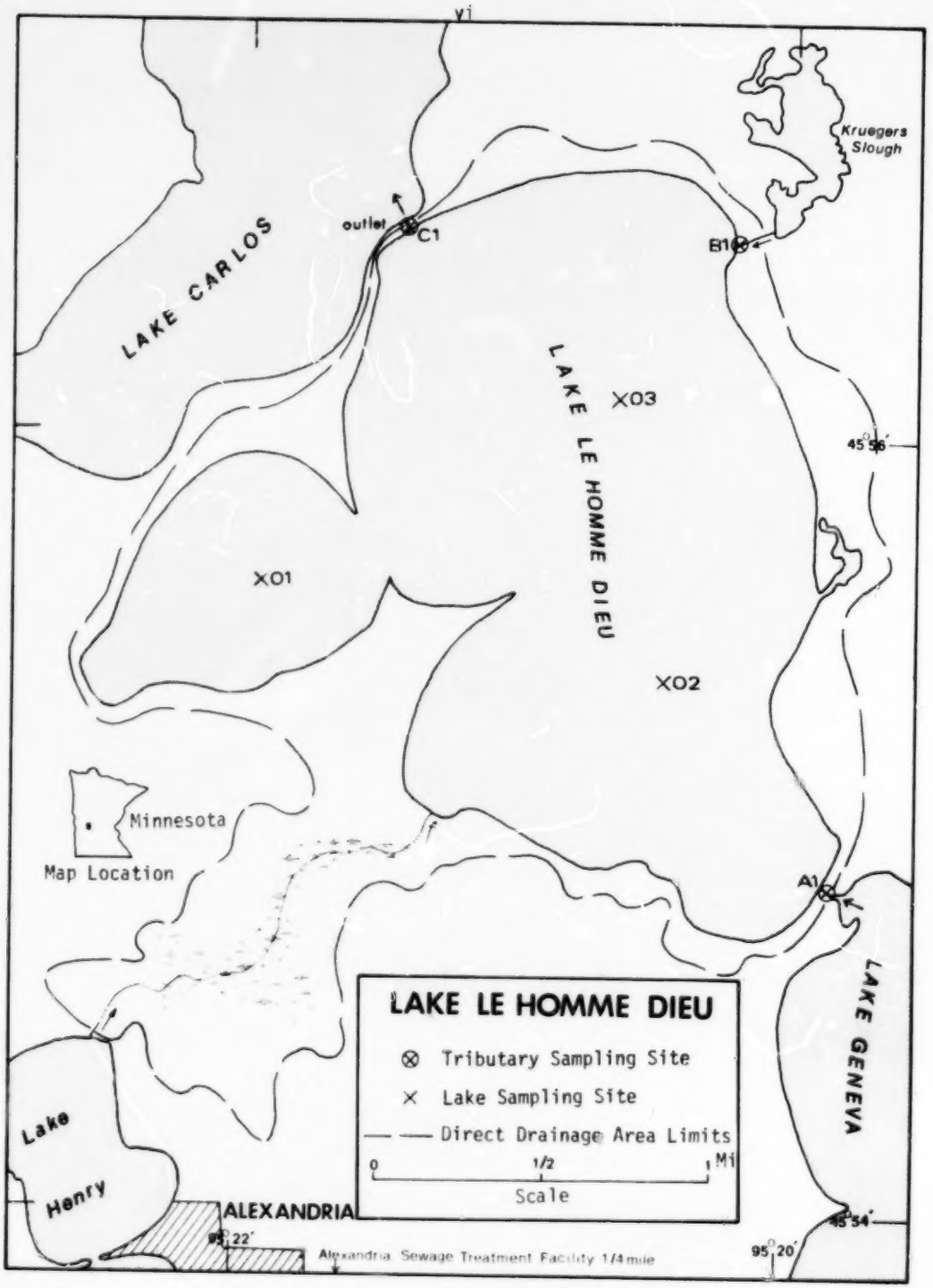
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


Kruegers Slough
outlet
C1
B1
LAKE CARLOS
LAKE LE HOMME DIEU
X03
X01
X02
45°56'
Minnesota
Map Location
A1
LAKE GENEVA
LAKE LE HOMME DIEU
Tributary Sampling Site
Lake Sampling Site
Direct Drainage Area Limits
0
1/2
1 Mi
Scale
Lake Henry
ALEXANDRIA
95°22'
Alexandria Sewage Treatment Facility 1/4 mile
45°54'
95°20'

LAKE LE HOMME DIEU

STORET NO. 2785

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Lake Le Homme Dieu is eutrophic, although water quality is relatively good. Of the 80 Minnesota lakes studied, only 11% had less mean total phosphorus, only 6% had less mean dissolved phosphorus, and only 6% had less algal assay control yield. However, 34% of the study lakes had less mean inorganic nitrogen, 16% had greater transparency, and 42% had less mean chlorophyll a. Marked depression of dissolved oxygen with depth was noted at all stations in July, and oxygen depletion at station 1 and near-depletion at station 2 occurred in August.

A small area of the lake was chemically treated for the control of rooted aquatic vegetation in 1971 (Bonnema and Johnson, 1972).

B. Rate-Limiting Nutrient:

The results of the algal assay show the lake was phosphorus limited at the time the sample was collected.

The lake data indicate phosphorus limitation in September but nitrogen limitation in July.

C. Nutrient Controllability:

1. Point sources--The elimination of the Alexandria Main plant discharge to Upper Lake Winona should result in a reduction of the present mesotrophic loading rate to Lake Le Homme Dieu (see "Report on Lake Winona", Working Paper No. 135, and page 13 of this report).

2. Non-point sources (see page 13)--The non-point nutrient exports to Lake Le Homme Dieu were exceptionally low because of nutrient entrapment in the water bodies tributary to this lake.

In all, non-point sources are estimated to have contributed about 43% of the total phosphorus load and about 75% of the total nitrogen load to the lake during the sampling year.

II. LAKE AND DRAINAGE BASIN CHARCTERISTICS

A. Lake Morphometry†:

1. Surface area: 1,744 acres.
2. Mean depth: 21 feet.
3. Maximum depth: 85 feet.
4. Volume: 36,624 acre/feet.
5. Mean hydraulic retention time: 7.9 years.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Lake Geneva outlet	29.2 mi^2	4.5 cfs
Krueger's Slough outlet	0.8 mi^2	0.1 cfs
Minor tributaries & immediate drainage -	9.6 mi^2	1.8 cfs
Totals	39.6 mi^2	6.4 cfs

2. Outlet -

Lake Carlos inlet	42.3 mi^2**	6.4 cfs

C. Precipitation***:

1. Year of sampling: 22.9 inches.
2. Mean annual: 22.6 inches.

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† Anonymous, 1969.
* Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
** Includes area of lake.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Lake Le Homme Dieu was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page vi). During each visit, a single depth-integrated (15 feet to surface) sample was composited from the three stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 46 feet at station 1, 42 feet at station 2, and 45 feet at station 3.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/28/72)		
Temperature (Cent.)	6.0	6.2	6.1	6.4
Dissolved oxygen (mg/l)	9.4	10.3	10.3	11.2
Conductivity (μmhos)	290	299	300	310
pH (units)	7.7	7.9	8.0	8.0
Alkalinity (mg/l)	162	170	168	216
Total P (mg/l)	0.014	0.017	0.016	0.034
Dissolved P (mg/l)	0.004	0.008	0.008	0.010
NO_2 + NO_3 (mg/l)	0.020	0.076	0.080	0.100
Ammonia (mg/l)	0.070	0.092	0.080	0.140
		ALL VALUES		
Secchi disc (inches)	48	91	72	144

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
07/06/72	1. Anabaena	3,261
	2. Microcystis	2,319
	3. Dinobryon	1,413
	4. Cyclotella	254
	5. Scenedesmus	145
	Other genera	796
	Total	8,188
09/02/72	1. Microcystis	4,493
	2. Merismopedia	906
	3. Chroococcus	833
	4. Lyngbya	580
	5. Dinobryon	362
	Other genera	761
	Total	7,935
10/28/72	1. Flagellates	2,264
	2. Dinobryon	1,585
	3. Scenedesmus	1,472
	4. Pediastrum	981
	5. Anabaena	377
	Other genera	1,396
	Total	8,075

2. Chlorophyll *a* -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
07/06/72	01	5.3
	02	6.4
	03	4.3
09/02/72	01	28.8
	02	13.7
	03	6.9
10/28/72	01	26.6
	02	14.7
	03	5.3

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.004	0.139	0.2
0.006 P	0.010	0.139	2.4
0.012 P	0.016	0.139	3.6
0.024 P	0.028	0.139	3.4
0.060 P	0.064	0.139	3.7
0.060 P + 10.0 N	0.064	10.139	34.3
10.0 N	0.004	10.139	0.2

2. Discussion -

The control yield of the assay alga, *Selenastrum capricornutum*, indicates that the potential primary productivity of Lake Le Homme Dieu was low at the time the sample was collected. Also, the increasing yields with increasing

increments of orthophosphorus (to about 0.020 mg/1) show that the lake was phosphorus limited at the time the sample was collected. Note that the addition of only nitrogen produced a yield not significantly different than the control yield.

The lake data indicate phosphorus limitation in September as well (N/P ratio = 30/1) but nitrogen limitation in July (N/P ratio = 10/1).

IV. NUTRIENT LOADINGS
(See Appendix C for all data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May, when two samples were collected, and the colder months when ice cover and low flows prevented sampling. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the nutrient loads, in $lbs/mi^2/year$, in Krueger's Slough outlet at station B-1 and multiplying by the ZZ area in mi^2.

The operator of the Alexandria Main wastewater treatment plant provided monthly effluent samples and corresponding flow data. The Alexandria plant discharges to Upper Lake Winona and thence to Lake Agnes to Lake Henry to a marsh area and, finally, to Lake Le Homme Dieu. Therefore, in the following loading tables, it is assumed that 95% of the Alexandria

* See Working Paper No. 1.

Main plant nutrient loads do not reach Lake Le Homme Dieu (it is known that the outflow of Lake Henry is intermittant*, but the duration of overflow periods is not known). The "at-the-plant" loads measured for the sampling year were 14,920 lbs P and 55,810 lbs N.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served†	Treatment	Mean Flow (mgd)	Receiving Water
Alexandria Main	5,090	trickling filter	0.664	Upper Lake Winona

2. Known industrial* -

Name	Treatment	Mean Flow (mgd)	Receiving Water
Land-O-Lakes Creamery, Alexandria	(cooling water)	?	Upper Lake Winona

* Bishop and McGuire, 1968.
† Estimated 73% of Alexandria population (1970 Census) served by this plant.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Lake Geneva outlet	340	19.8
Krueger's Slough outlet	10	0.6
b. Minor tributaries & immediate drainage (non-point load) -	120	7.0
c. Known municipal -		
Alexandria (Main Plant)	750	43.6
d. Septic tanks* -	230	13.4
e. Known industrial -		
Land-O-Lakes Creamery	?	-
f. Direct precipitation** -	270	15.6
Total	1,720	100.0

2. Outputs -

Lake outlet - Lake Carlos inlet 370

3. Net annual P accumulation - 1,350 pounds

* Estimated 371 dwellings on shoreline; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Lake Geneva outlet	14,750	31.4
Krueger's Slough outlet	300	0.6
b. Minor tributaries & immediate drainage (non-point load) -	3,600	7.7
c. Known municipal -		
Alexandria (Main Plant)	2,790	5.9
d. Septic tanks* -	8,720	18.6
e. Known industrial -		
Land-O-Lakes Creamery	?	-
f. Direct precipitation** -	16,800	35.8
Total	46,960	100.0

2. Outputs -

Lake outlet - Lake Carlos inlet 17,860

3. Net annual N accumulation - 29,100 pounds

* Estimated 371 dwellings on shoreline; see Working Paper No. 1.
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
Lake Geneva outlet	12	505
Krueger's Slough outlet	12	375

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Units	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
lbs/acre/yr	1.1	0.9	29.9	19.7
grams/m^2/yr	0.12	0.10	3.4	2.2

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Lake Le Homme Dieu:

"Dangerous" (eutrophic rate)	0.18
"Permissible" (oligotrophic rate)	0.09

V. LITERATURE REVIEWED

Anonymous, 1969. Report on water quality investigation of Long Prairie River and lakes Carlos, Le Homme Dieu, and Osakis. MPCA, Minneapolis.

Bishop, Kyle M., and John F. McGuire, 1968. Report on pollution of lakes Winona, Agnes and Henry. MPCA, Minneapolis.

Bonnema, Kenneth, and William G. Johnson, 1972. Control of aquatic vegetation, algae, leeches, and swimmer's itch in 1971. MN Dept. of Nat. Resources, Minneapolis.

Vollenweider, Richard A., (in press). Input-output models. Schwiez. A. Hydrol.

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 27MS LAKE OF HOWLING DEER

TOTAL DRAINAGE AREA OF LAKE 42.30

TRIBUTARY	SUB-DRAINAGE AREA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
						NORMALIZED FLOWS								
27MSA1	24.20	0.35	0.29	3.58	12.40	7.84	4.72	5.29	3.09	1.97	4.00	3.01	1.09	4.47
27MSB1	0.40	0.01	0.01	0.05	0.10	0.22	0.28	0.15	0.09	0.07	0.12	0.08	0.03	0.12
27MSC1	42.30	0.45	0.37	4.58	14.29	11.36	13.48	7.54	4.56	2.77	5.85	4.48	1.46	6.41
27MSZ7	17.70	0.17	0.14	1.40	5.63	3.24	4.12	2.20	1.21	0.67	1.63	1.14	0.50	1.82

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 42.33
SUM OF SUB-DRAINAGE AREAS = 42.30

TOTAL FLOW IN = 76.81
TOTAL FLOW OUT = 76.80

NOTE *** TRIB MSC1=MSC1

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27MSA1	10	72	10.40	14	11.70				
	11	72	9.24	15	8.80				
	12	72	4.64	15	4.50				
	1	73	1.71						
	2	73	3.66	21	3.60				
	3	73	15.10	13	14.00				
	4	73	15.73	5	20.00	19	15.00		
	5	73	13.50	3	15.00	17	12.00		
	6	73	9.41	8	11.00				
	7	73	6.60	11	6.21				
	8	73	5.27	23	5.17				
	9	73	3.39	18	2.54				
27MSB1	10	72	0.33	14	0.43				
	11	72	0.26	15	0.20				
	12	72	0.13	15	0.10				
	1	73	0.05						
	2	73	0.05	21	0.05				
	3	73	0.36	13	0.30				
	4	73	0.37	5	0.50	19	0.40		
	5	73	0.36	3	0.40	17	0.30		
	6	73	0.26	8	0.36				
	7	73	0.18	11	0.14				
	8	73	0.15	23	0.13				
	9	73	0.11	18	0.09				

16.

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 2745 LAKE LE HOMME DIEU

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2795C1	10	72	17.80	14	19.00				
	11	72	15.10	15	15.00				
	12	72	7.01	15	6.70				
	1	73	2.54						
	2	73	5.46	21	2.50				
	3	73	23.00	13	20.00				
	4	73	25.70	5	32.00	19	24.00		
	5	73	21.00	3	24.00	17	20.00		
	6	73	15.80	8	18.00				
	7	73	10.30	11	9.95				
	8	73	9.67	23	8.51				
	9	73	4.85	30	3.98				
2795Z7	10	72	4.43	14	4.70				
	11	72	3.47	15	3.40				
	12	72	2.15	15	2.10				
	1	73	0.83						
	2	73	1.54	21	0.80				
	3	73	6.30	13	5.40				
	4	73	6.14	5	7.70	19	5.80		
	5	73	5.35	3	6.20	17	5.10		
	6	73	4.21	8	4.80				
	7	73	2.66	11	2.58				
	8	73	2.30	23	2.02				
	9	73	1.37	18	1.12	30	1.12		

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

27H501
45 55 40.0 095 21 55.0
LE HOMME DIEU
27 MINNESOTA

11EPALES
3

2111202
0042 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/06	12 42	0000			48	305	8.50	172	0.060	0.070	0.020	0.009
	12 42	0004	21.0	9.5		305	8.50	175	0.050	0.050	0.012	0.007
	12 42	0015	19.8	9.7		325	7.80	188	0.040	0.060	0.024	0.011
	12 42	0020	11.0									
	12 42	0022	13.0	6.2		340	7.50	164	0.060	0.030	0.036	0.014
	12 42	0032	8.0	2.4		340	7.50	187	0.050	0.050	0.044	0.014
72/09/02	16 05	0000			72	302	8.50	144	0.140	0.170	0.015	0.012
	16 05	0004	19.6	9.1		300	8.60	143	0.150	0.160	0.013	0.012
	16 05	0015	19.2	8.2		290	8.55	144	0.150	0.160	0.017	0.010
	16 05	0022	18.2	2.6		315	8.05	146	0.140	0.140	0.016	0.014
	16 05	0030	11.1	0.3		360	7.40	187	0.120	0.310	0.022	0.009
	16 05	0038	9.3	0.0		358	7.35	186	0.160	0.680	0.015	0.011
	16 05	0046	7.9	0.0		370	7.30	190	0.120	1.170	0.028	0.018
72/10/28	09 35	0000			144	290	8.00	165	0.060	0.130	0.014	0.009
	09 35	0004	6.4	10.8		300	8.00	170	0.050	0.120	0.015	0.008
	09 35	0015	6.4	10.2		300	8.00	169	0.050	0.130	0.015	0.008
	09 35	0025	6.4	9.4		300	8.00	173	0.060	0.140	0.015	0.005
	09 35	0032	6.4	11.2		300	8.00	216	0.020	0.100	0.017	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/07/06	12 42	0000	5.3J
72/09/02	16 05	0000	6.4J
72/10/28	09 35	0000	4.3J

J VALUE KNOWN TO BE IN ERROR

19

STORET RETRIEVAL DATE 74/10/30

278502
45 55 22.0 095 20 27.0
LE HOMME DIEU
27 MINNESOTA

11EPALES
3

2111202
0040 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/07	15	30 0000			72	320	8.50					
	15	30 0004	21.5	11.8				164	0.030	0.050	0.022	0.009
	15	30 0015	18.0	9.4		320	8.40	175	0.040	0.020	0.023	0.011
	15	30 0022	17.0	6.2		345	8.00	175	0.040	0.010	0.030	0.011
	15	30 0036	8.5	2.2		355	7.40	182	0.070	0.070	0.031	0.014
72/09/02	16	35 0000			72	305	8.53	145	0.120	0.140	0.023	0.014
	16	35 0004	19.5	9.0		300	8.55	144	0.100	0.120	0.022	0.012
	16	35 0015	19.1	8.2		302	8.50	144	0.080	0.130	0.021	0.011
	16	35 0022	19.1	7.2		300	8.50	144	0.080	0.130	0.018	0.014
	16	35 0030	15.1	0.3		320	7.58	170	0.100	0.140	0.016	0.010
	16	35 0042	9.2	0.3		360	7.40	180	0.150	0.750	0.054	0.028
72/10/28	10	20 0000			136	300	7.90	167	0.090	0.080	0.015	0.008
	10	20 0004	6.2	10.8		295	8.00	162	0.080	0.080	0.020	0.010
	10	20 0015	6.2	9.4		290	8.00	163	0.080	0.080	0.014	0.009
	10	20 0025	6.1	10.3		295	8.00	164	0.080	0.070	0.018	0.004
	10	20 0035	6.1	10.4		300	8.00	165	0.090	0.080	0.018	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/07/07	15	30 0000	28.8J
72/09/02	16	35 0000	13.7J
72/10/28	10	20 0000	6.9J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

27MS03
45 56 06.0 095 20 40.0
LE HOMME DIEU
27 MINNESOTA

11EPALES 2111202
3 0034 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/07	16	00 0000			76	325	8.40	164	0.060	0.060	0.016	0.008
	16	00 0004	21.4	12.6				162	0.050	0.230	0.019	0.009
	16	00 0015	20.0	9.8		340	8.20	169	0.060	0.070	0.016	0.014
	16	00 0020	19.0									
	16	00 0022	18.5	5.8		335	8.20	164	0.040	0.080	0.025	0.010
	16	00 0032	16.5	3.4		340	7.60	164	0.040	0.020	0.047	0.010
72/09/02	17	05 0000			60	309	8.60	142	0.130	0.150	0.022	0.010
	17	05 0004	20.3	10.1		320	8.60	142	0.140	0.150	0.023	0.015
	17	05 0015	19.5	7.3		300	8.50	142	0.120	0.150	0.022	0.011
	17	05 0022	19.3	6.5		305	8.40	144	0.120	0.140	0.022	0.013
	17	05 0029	19.2	6.7		305	8.40	143	0.080	0.150	0.022	0.012
72/10/29	10	50 0000			140	310	7.70	166	0.100	0.080	0.015	0.007
	10	50 0004	6.0	10.5		300	7.90	169	0.090	0.080	0.015	0.007
	10	50 0015	6.0	9.8		300	7.90	168	0.080	0.070	0.016	0.008
	10	50 0025	6.0	10.3		300	7.90	170	0.090	0.080	0.020	0.008
	10	50 0035	6.0	10.1		300	7.90	171	0.100	0.080	0.017	0.008
	10	50 0045	6.0	10.3		300	8.00	167	0.090	0.080	0.034	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/07/07	16	00 0000	26.6J
72/09/02	17	05 0000	14.7J
72/10/29	10	50 0000	5.3J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/10/30

2745A1 LS2745A1
45 55 00.0 095 20 00.0
LK LE HOMME DIEU/LK GENEVA CONN
27 7.5 ALEXANDRIA E
1/LAKE LE HOMME DIEU
ST HWY 29 BRDG 2 MI NE OF ALEXANDRIA
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	11	15	0.075	0.990	0.066	0.006	0.041
72/11/15	15	10	0.120	3.600	0.290	0.017	0.036
73/02/21	12	35	0.072	0.795	0.052	0.005K	0.030
73/03/13	15	40	0.180	0.840	0.147	0.011	0.025
73/04/05	15	15	0.066	2.000	0.033	0.005K	0.030
73/04/19	15	40	0.033	3.100	0.053	0.012	0.085
73/05/03	15	30	0.017	0.740	0.008	0.006	0.030
73/05/17	15	40	0.010K	1.000	0.048	0.008	0.040
73/06/08	11	30	0.010K	0.540	0.005K	0.005K	0.020
73/07/11	15	20	0.011	0.880	0.048	0.012	0.025
73/08/23			0.019	3.300	0.370	0.015	0.050
73/09/18	15	50	0.010K	1.200	0.054	0.005K	0.025

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27RSB1 LS27RSB1
45 56 30.0 095 20 00.0
OUTLET OF KRUEGERS SLOUGH
27 7.5 ALEXANDRIA E
T/LAKE LE HOMME DIEU
CO HWY 20 XING 2.75 MI SW OF CARLOS
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	11 05		0.068	0.800	0.060	0.005K	0.015
72/11/15	15 15		0.018	0.660	0.038	0.009	0.008
72/12/15	11 45		0.048	0.840	0.056	0.005K	0.013
73/03/13	15 45		0.027	1.600	0.550	0.009	0.055
73/04/05	15 00		0.011	2.310	0.063	0.005K	0.020
73/04/19	15 20		0.023	1.540	0.095	0.005K	0.020
73/05/03	15 25		0.011	0.630	0.008	0.006	0.015
73/05/17	15 30		0.010K	0.790	0.005K	0.005K	0.010
73/06/08	11 25		0.010K	0.720	0.044	0.005K	0.022
73/07/11	15 10		0.015	1.980	0.064	0.012	0.030
73/08/23			0.017	0.920	0.060	0.007	0.035
73/09/18	15 15		0.010K	1.890	0.075	0.005K	0.015

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

278551 TF278551 P006973
45 53 00.0 095 22 00.0
ALEXANDRIA
27 7.5 E ALEXANDRIA
T/LAKE LE HOMME DIU
UNKNOWN
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/02/01	10 00								
CP(T)-			7.100	22.000	4.800	5.100	7.900	0.662	0.658
73/02/01	15 00								
73/03/01	10 00								
CP(T)-			11.300	5.200	0.570	4.100	4.100	0.698	0.623
73/03/01	15 00								
73/04/01	10 00								
CP(T)-			3.700	24.000	5.200	4.300	7.500	0.640	0.623
73/04/01	15 00								
73/05/01	10 00								
CP(T)-			7.600	19.000	7.300	5.500	6.500	0.698	0.677
73/05/01	15 00								
73/06/04	10 00								
CP(T)-			6.400	16.000	0.540	5.750	6.200	0.749	0.718
73/06/04	15 00								
73/08/01	10 00								
CP(T)-			6.500	23.000	3.900	4.350	5.900	0.749	0.708
73/08/01	15 00								
73/09/04	10 30		7.300	20.700	6.800			0.691	0.694
73/10/01	10 30								
CP(T)-			13.400	4.600	0.290	9.600	9.900	0.640	0.664
73/10/01	15 00								
73/11/08	10 00								
CP(T)-			4.500	34.000	17.000	4.400	6.050	0.749	0.645
73/11/08	15 00								
73/12/07	10 00								
CP(T)-			5.900	29.000	13.000	4.400	10.500	0.654	0.648
73/12/07	14 00								
74/01/04	10 00								
CP(T)-			10.100	22.000	5.700	8.600	9.450	0.691	0.673
74/01/04	14 01								
74/02/07	10 00								
CP(T)-			6.900	26.500	6.350	6.300	8.000	0.619	0.673
74/02/07	14 00								